Black-Scholes Options Pricing Model

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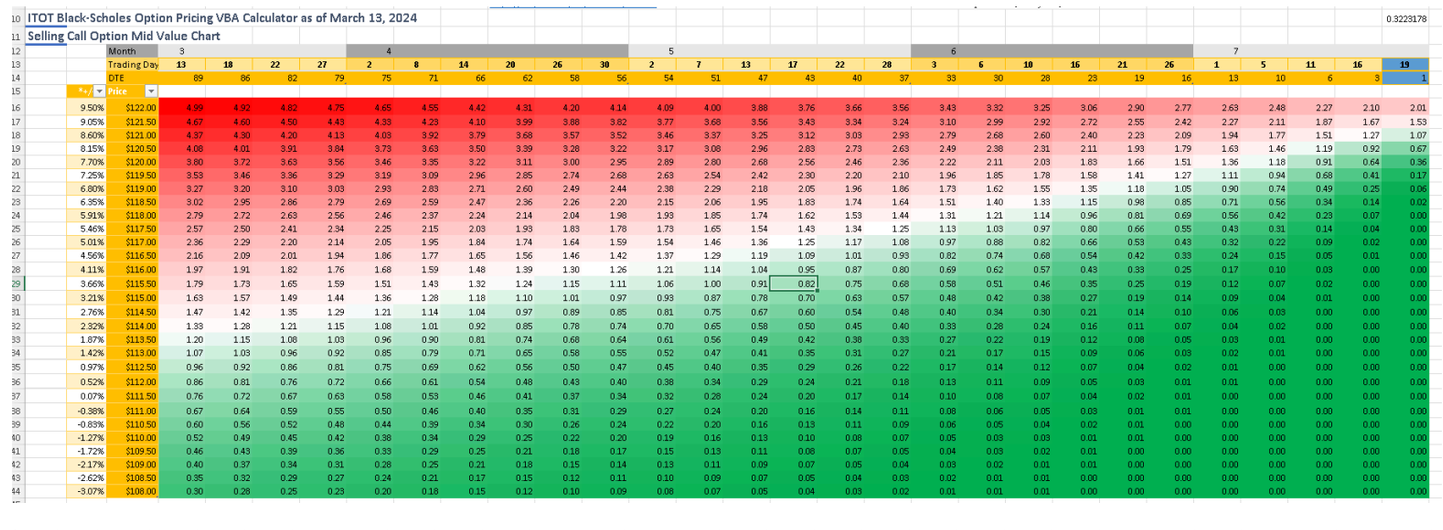
Overview

This document highlights the process of creating the Black-Scholes option pricing model for buy and sell call contract of ITOT(iShares Core S&P Total US Stock Market ETF) as of March 13, 2024, expiring on July 19, 2024. Final Result below, sell(top) and buy(bottom).



ITOT Black-Scholes Option Pricing VBA Calculator as of March 13, 2024 — 0.3223178

Selling Call Option Mid Value Chart

Month		3				4							5						6						7				
Trading Day		13	18	22	27	2	8	14	20	26	30	2	7	13	17	22	28	3	6	10	16	21	26	1	5	11	16	19
DTE		89	86	82	79	75	71	66	62	58	56	54	51	47	43	40	37	33	30	28	23	19	16	13	10	6	3	1
%/	Price																											
9.50%	$122.00	4.99	4.92	4.82	4.75	4.65	4.55	4.42	4.31	4.20	4.14	4.09	4.00	3.88	3.76	3.66	3.56	3.43	3.32	3.25	3.06	2.90	2.77	2.63	2.48	2.27	2.10	2.01
9.05%	$121.50	4.67	4.60	4.50	4.43	4.33	4.23	4.10	3.99	3.88	3.82	3.77	3.68	3.56	3.43	3.34	3.24	3.10	2.99	2.92	2.72	2.55	2.42	2.27	2.11	1.87	1.67	1.53
8.60%	$121.00	4.37	4.30	4.20	4.13	4.03	3.92	3.79	3.68	3.57	3.52	3.46	3.37	3.25	3.12	3.03	2.93	2.79	2.68	2.60	2.40	2.23	2.09	1.94	1.77	1.51	1.27	1.07
8.15%	$120.50	4.08	4.01	3.91	3.84	3.73	3.63	3.50	3.39	3.28	3.22	3.17	3.08	2.96	2.83	2.73	2.63	2.49	2.38	2.31	2.11	1.93	1.79	1.63	1.46	1.19	0.92	0.67
7.70%	$120.00	3.80	3.72	3.63	3.56	3.46	3.35	3.22	3.11	3.00	2.95	2.89	2.80	2.68	2.56	2.46	2.36	2.22	2.11	2.03	1.83	1.66	1.51	1.36	1.18	0.91	0.64	0.36
7.25%	$119.50	3.53	3.46	3.36	3.29	3.19	3.09	2.96	2.85	2.74	2.68	2.63	2.54	2.42	2.30	2.20	2.10	1.96	1.85	1.78	1.58	1.41	1.27	1.11	0.94	0.68	0.41	0.17
6.80%	$119.00	3.27	3.20	3.10	3.03	2.93	2.83	2.71	2.60	2.49	2.44	2.38	2.29	2.18	2.05	1.96	1.86	1.73	1.62	1.55	1.35	1.18	1.05	0.90	0.74	0.49	0.25	0.06
6.35%	$118.50	3.02	2.95	2.86	2.79	2.69	2.59	2.47	2.36	2.26	2.20	2.15	2.06	1.95	1.83	1.74	1.64	1.51	1.40	1.33	1.15	0.98	0.85	0.71	0.56	0.34	0.14	0.02
5.91%	$118.00	2.79	2.72	2.63	2.56	2.46	2.37	2.24	2.14	2.04	1.98	1.93	1.85	1.74	1.62	1.53	1.44	1.31	1.21	1.14	0.96	0.81	0.69	0.56	0.42	0.23	0.07	0.00
5.46%	$117.50	2.57	2.50	2.41	2.34	2.25	2.15	2.03	1.93	1.83	1.78	1.73	1.65	1.54	1.43	1.34	1.25	1.13	1.03	0.97	0.80	0.66	0.55	0.43	0.31	0.14	0.04	0.00
5.01%	$117.00	2.36	2.29	2.20	2.14	2.05	1.95	1.84	1.74	1.64	1.59	1.54	1.46	1.36	1.25	1.17	1.08	0.97	0.88	0.82	0.66	0.53	0.43	0.32	0.22	0.09	0.02	0.00
4.56%	$116.50	2.16	2.09	2.01	1.94	1.86	1.77	1.65	1.56	1.46	1.42	1.37	1.29	1.19	1.09	1.01	0.93	0.82	0.74	0.68	0.54	0.42	0.33	0.24	0.15	0.05	0.01	0.00
4.11%	$116.00	1.97	1.91	1.82	1.76	1.68	1.59	1.48	1.39	1.30	1.26	1.21	1.14	1.04	0.95	0.87	0.80	0.69	0.62	0.57	0.43	0.33	0.25	0.17	0.10	0.03	0.00	0.00
3.66%	$115.50	1.79	1.73	1.65	1.59	1.51	1.43	1.32	1.24	1.15	1.11	1.06	1.00	0.91	0.82	0.75	0.68	0.58	0.51	0.46	0.35	0.25	0.19	0.12	0.07	0.02	0.00	0.00
3.21%	$115.00	1.63	1.57	1.49	1.44	1.36	1.28	1.18	1.10	1.01	0.97	0.93	0.87	0.78	0.70	0.63	0.57	0.48	0.42	0.38	0.27	0.19	0.14	0.09	0.04	0.01	0.00	0.00
2.76%	$114.50	1.47	1.42	1.35	1.29	1.21	1.14	1.04	0.97	0.89	0.85	0.81	0.75	0.67	0.60	0.54	0.48	0.40	0.34	0.30	0.21	0.14	0.10	0.06	0.03	0.00	0.00	0.00
2.32%	$114.00	1.33	1.28	1.21	1.15	1.08	1.01	0.92	0.85	0.78	0.74	0.70	0.65	0.58	0.50	0.45	0.40	0.33	0.28	0.24	0.16	0.11	0.07	0.04	0.02	0.00	0.00	0.00
1.87%	$113.50	1.20	1.15	1.08	1.03	0.96	0.90	0.81	0.74	0.68	0.64	0.61	0.56	0.49	0.42	0.38	0.33	0.27	0.22	0.19	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.00
1.42%	$113.00	1.07	1.03	0.96	0.92	0.85	0.79	0.71	0.65	0.58	0.55	0.52	0.47	0.41	0.35	0.31	0.27	0.21	0.17	0.15	0.09	0.06	0.03	0.02	0.01	0.00	0.00	0.00
0.97%	$112.50	0.96	0.92	0.86	0.81	0.75	0.69	0.62	0.56	0.50	0.47	0.45	0.40	0.35	0.29	0.26	0.22	0.17	0.14	0.12	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00
0.52%	$112.00	0.86	0.81	0.76	0.72	0.66	0.61	0.54	0.48	0.43	0.40	0.38	0.34	0.29	0.24	0.21	0.18	0.13	0.11	0.09	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00
0.07%	$111.50	0.76	0.72	0.67	0.63	0.58	0.53	0.46	0.41	0.37	0.34	0.32	0.28	0.24	0.20	0.17	0.14	0.10	0.08	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00
-0.38%	$111.00	0.67	0.64	0.59	0.55	0.50	0.46	0.40	0.35	0.31	0.29	0.27	0.24	0.20	0.16	0.14	0.11	0.08	0.06	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00
-0.83%	$110.50	0.60	0.56	0.52	0.48	0.44	0.39	0.34	0.30	0.26	0.24	0.22	0.20	0.16	0.13	0.11	0.09	0.06	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
-1.27%	$110.00	0.52	0.49	0.45	0.42	0.38	0.34	0.29	0.25	0.22	0.20	0.19	0.16	0.13	0.10	0.08	0.07	0.05	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
-1.72%	$109.50	0.46	0.43	0.39	0.36	0.33	0.29	0.25	0.21	0.18	0.17	0.15	0.13	0.11	0.08	0.07	0.05	0.04	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-2.17%	$109.00	0.40	0.37	0.34	0.31	0.28	0.25	0.21	0.18	0.15	0.14	0.13	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-2.62%	$108.50	0.35	0.32	0.29	0.27	0.24	0.21	0.17	0.15	0.12	0.11	0.10	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3.07%	$108.00	0.30	0.28	0.25	0.23	0.20	0.18	0.15	0.12	0.10	0.09	0.08	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Buying Call Option Mid Value Chart

Month		3				4							5						6						7				
Trading Day		13	18	22	27	2	8	14	20	26	30	2	7	13	17	22	28	3	6	10	16	21	26	1	5	11	16	19
DTE		89	86	82	79	75	71	66	62	58	56	54	51	47	43	40	37	33	30	28	23	19	16	13	10	6	3	1
%/	Price																											
9.50%	$122.00	4.99	4.92	4.82	4.75	4.65	4.55	4.42	4.31	4.20	4.14	4.09	4.00	3.88	3.76	3.66	3.56	3.43	3.32	3.25	3.06	2.90	2.77	2.63	2.48	2.27	2.10	2.01
9.05%	$121.50	4.67	4.60	4.50	4.43	4.33	4.23	4.10	3.99	3.88	3.82	3.77	3.68	3.56	3.43	3.34	3.24	3.10	2.99	2.92	2.72	2.55	2.42	2.27	2.11	1.87	1.67	1.53
8.60%	$121.00	4.37	4.30	4.20	4.13	4.03	3.92	3.79	3.68	3.57	3.52	3.46	3.37	3.25	3.12	3.03	2.93	2.79	2.68	2.60	2.40	2.23	2.09	1.94	1.77	1.51	1.27	1.07
8.15%	$120.50	4.08	4.01	3.91	3.84	3.73	3.63	3.50	3.39	3.28	3.22	3.17	3.08	2.96	2.83	2.73	2.63	2.49	2.38	2.31	2.11	1.93	1.79	1.63	1.46	1.19	0.92	0.67
7.70%	$120.00	3.80	3.72	3.63	3.56	3.46	3.35	3.22	3.11	3.00	2.95	2.89	2.80	2.68	2.56	2.46	2.36	2.22	2.11	2.03	1.83	1.66	1.51	1.36	1.18	0.91	0.64	0.36
7.25%	$119.50	3.53	3.46	3.36	3.29	3.19	3.09	2.96	2.85	2.74	2.68	2.63	2.54	2.42	2.30	2.20	2.10	1.96	1.85	1.78	1.58	1.41	1.27	1.11	0.94	0.68	0.41	0.17
6.80%	$119.00	3.27	3.20	3.10	3.03	2.93	2.83	2.71	2.60	2.49	2.44	2.38	2.29	2.18	2.05	1.96	1.86	1.73	1.62	1.55	1.35	1.18	1.05	0.90	0.74	0.49	0.25	0.06
6.35%	$118.50	3.02	2.95	2.86	2.79	2.69	2.59	2.47	2.36	2.26	2.20	2.15	2.06	1.95	1.83	1.74	1.64	1.51	1.40	1.33	1.15	0.98	0.85	0.71	0.56	0.34	0.14	0.02
5.91%	$118.00	2.79	2.72	2.63	2.56	2.46	2.37	2.24	2.14	2.04	1.98	1.93	1.85	1.74	1.62	1.53	1.44	1.31	1.21	1.14	0.96	0.81	0.69	0.56	0.42	0.23	0.07	0.00
5.46%	$117.50	2.57	2.50	2.41	2.34	2.25	2.15	2.03	1.93	1.83	1.78	1.73	1.65	1.54	1.43	1.34	1.25	1.13	1.03	0.97	0.80	0.66	0.55	0.43	0.31	0.14	0.04	0.00
5.01%	$117.00	2.36	2.29	2.20	2.14	2.05	1.95	1.84	1.74	1.64	1.59	1.54	1.46	1.36	1.25	1.17	1.08	0.97	0.88	0.82	0.66	0.53	0.43	0.32	0.22	0.09	0.02	0.00
4.56%	$116.50	2.16	2.09	2.01	1.94	1.86	1.77	1.65	1.56	1.46	1.42	1.37	1.29	1.19	1.09	1.01	0.93	0.82	0.74	0.68	0.54	0.42	0.33	0.24	0.15	0.05	0.01	0.00
4.11%	$116.00	1.97	1.91	1.82	1.76	1.68	1.59	1.48	1.39	1.30	1.26	1.21	1.14	1.04	0.95	0.87	0.80	0.69	0.62	0.57	0.43	0.33	0.25	0.17	0.10	0.03	0.00	0.00
3.66%	$115.50	1.79	1.73	1.65	1.59	1.51	1.43	1.32	1.24	1.15	1.11	1.06	1.00	0.91	0.82	0.75	0.68	0.58	0.51	0.46	0.35	0.25	0.19	0.12	0.07	0.02	0.00	0.00
3.21%	$115.00	1.63	1.57	1.49	1.44	1.36	1.28	1.18	1.10	1.01	0.97	0.93	0.87	0.78	0.70	0.63	0.57	0.48	0.42	0.38	0.27	0.19	0.14	0.09	0.04	0.01	0.00	0.00
2.76%	$114.50	1.47	1.42	1.35	1.29	1.21	1.14	1.04	0.97	0.89	0.85	0.81	0.75	0.67	0.60	0.54	0.48	0.40	0.34	0.30	0.21	0.14	0.10	0.06	0.03	0.00	0.00	0.00
2.32%	$114.00	1.33	1.28	1.21	1.15	1.08	1.01	0.92	0.85	0.78	0.74	0.70	0.65	0.58	0.50	0.45	0.40	0.33	0.28	0.24	0.16	0.11	0.07	0.04	0.02	0.00	0.00	0.00
1.87%	$113.50	1.20	1.15	1.08	1.03	0.96	0.90	0.81	0.74	0.68	0.64	0.61	0.56	0.49	0.42	0.38	0.33	0.27	0.22	0.19	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.00
1.42%	$113.00	1.07	1.03	0.96	0.92	0.85	0.79	0.71	0.65	0.58	0.55	0.52	0.47	0.41	0.35	0.31	0.27	0.21	0.17	0.15	0.09	0.06	0.03	0.02	0.01	0.00	0.00	0.00
0.97%	$112.50	0.96	0.92	0.86	0.81	0.75	0.69	0.62	0.56	0.50	0.47	0.45	0.40	0.35	0.29	0.26	0.22	0.17	0.14	0.12	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00
0.52%	$112.00	0.86	0.81	0.76	0.72	0.66	0.61	0.54	0.48	0.43	0.40	0.38	0.34	0.29	0.24	0.21	0.18	0.13	0.11	0.09	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00
0.07%	$111.50	0.76	0.72	0.67	0.63	0.58	0.53	0.46	0.41	0.37	0.34	0.32	0.28	0.24	0.20	0.17	0.14	0.10	0.08	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00
-0.38%	$111.00	0.67	0.64	0.59	0.55	0.50	0.46	0.40	0.35	0.31	0.29	0.27	0.24	0.20	0.16	0.14	0.11	0.08	0.06	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00
-0.83%	$110.50	0.60	0.56	0.52	0.48	0.44	0.39	0.34	0.30	0.26	0.24	0.22	0.20	0.16	0.13	0.11	0.09	0.06	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
-1.27%	$110.00	0.52	0.49	0.45	0.42	0.38	0.34	0.29	0.25	0.22	0.20	0.19	0.16	0.13	0.10	0.08	0.07	0.05	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
-1.72%	$109.50	0.46	0.43	0.39	0.36	0.33	0.29	0.25	0.21	0.18	0.17	0.15	0.13	0.11	0.08	0.07	0.05	0.04	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-2.17%	$109.00	0.40	0.37	0.34	0.31	0.28	0.25	0.21	0.18	0.15	0.14	0.13	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-2.62%	$108.50	0.35	0.32	0.29	0.27	0.24	0.21	0.17	0.15	0.12	0.11	0.10	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3.07%	$108.00	0.30	0.28	0.25	0.23	0.20	0.18	0.15	0.12	0.10	0.09	0.08	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Tools & skills used

- Microsoft Excel
- VBA(Visual Basic for Applications) to create specific function
  - “DaysUntilExpiration(date(yyyy,mm,dd), date(2024,7,19))”
  - “BlackScholesCallPrice(UnderlyingPrice, DaysUntilExpiration)”
  - “BlackScholesPutPrice(UnderlyingPrice, DaysUntilExpiration)” - Put contracts were excluded
- Yahoo Finance for sourcing historic price data of ITOT
  - Calculated standard daily deviation YTD; further used for volatility parameter
- Option Contract Parameters
  - Underlying strike price
  - Strike price
  - Volatility
  - Interest Rate (10 yr Treasury rate)
  - Dividend yield
  - Time Until Expiration

Project Timeline: Processes, Challenges, and Solutions(chronological order)

Here I input the historical price data 0/2/24 to 0/3/24(cropped out) from Yahoo Finance which was used to find the standard daily deviation 'year to date' of ITOT. This would be used to calculate parameters such as volatility.

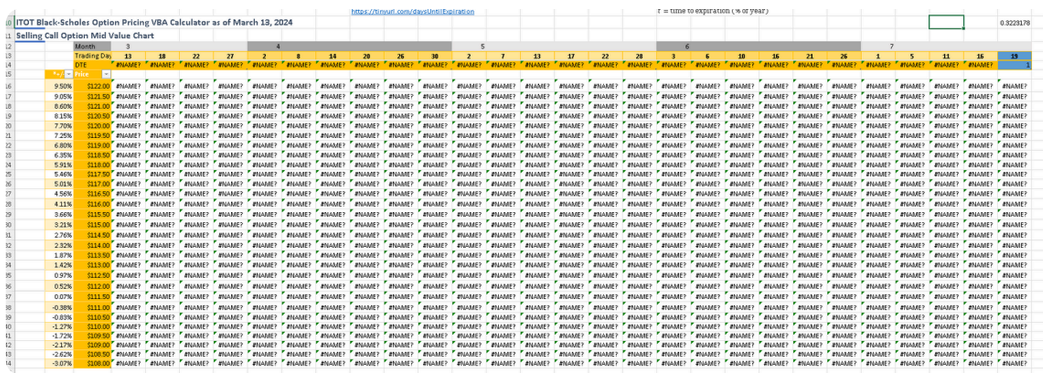
AJ	AK	AL	AM	AN
Open/Close, %Change, YTD				
Date	Open Pri	Close Pric	%Chan	Standard Daily Deviation YT
2-Jan-24	104.47	104.51		0.007451578
3-Jan-24	103.97	103.43	-1.03%	
4-Jan-24	103.35	103.16	-0.26%	
5-Jan-24	103.14	103.32	0.16%	
8-Jan-24	103.41	104.78	1.41%	
9-Jan-24	104.18	104.59	-0.18%	
########	104.67	105.13	0.52%	
11-Jan-24	105.28	105.05	-0.08%	
########	105.41	105.09	0.04%	
########	104.71	104.6	-0.47%	
########	103.9	104.03	-0.54%	
########	104.43	104.88	0.82%	
########	105.2	106.22	1.28%	
########	106.58	106.61	0.37%	
########	106.77	106.84	0.22%	
########	107.51	106.83	-0.01%	
########	107.36	107.39	0.52%	
########	107.34	107.31	-0.07%	
########	107.39	108.32	0.94%	
########	108.11	108.11	-0.19%	
########	107.66	106.33	-1.65%	
1-Feb-24	106.65	107.7	1.29%	
2-Feb-24	107.68	108.7	0.93%	
5-Feb-24	108.49	108.21	-0.45%	
6-Feb-24	108.34	108.51	0.28%	
7-Feb-24	109.07	109.37	0.79%	
8-Feb-24	109.39	109.65	0.26%	
9-Feb-24	109.76	110.33	0.62%	
########	110.33	110.42	0.08%	
########	108.84	108.66	-1.59%	
########	109.34	109.88	1.12%	
########	110.13	110.73	0.77%	
########	110.66	110.14	-0.53%	
########	109.7	109.44	-0.64%	

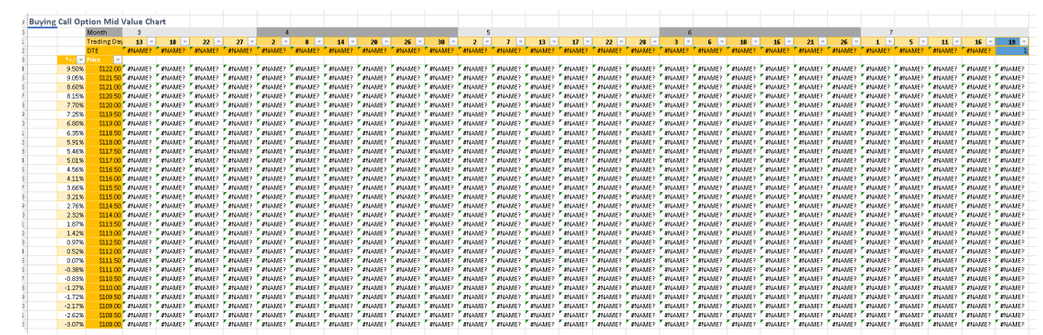
Parameters - 3/13/24	
Underlying Price S	113.6
strike price K	120
volatility σ	14.24%
Interest rate r	4.19%
Dividend yld q	1.70%
DTE	90
Time to exp t	24.66%
ln(S/K)	-0.0548
t(r-q+σ^2/2)	0.0086
σ*sqrt(t)	0.0707
d_1	-0.6531
d_2	-0.7238
$N(d_1)$	0.2568
$N(d_2)$	0.2346
$N(-d_1)$	0.7432
N(-d2)	0.7654
e^{-rt}	0.9897
Xe^{-rt}	118.7666
e^{-qt}	0.9958
Se^{-qt}	113.1248

I then found the following option contract parameters based on the Black-Scholes equation.

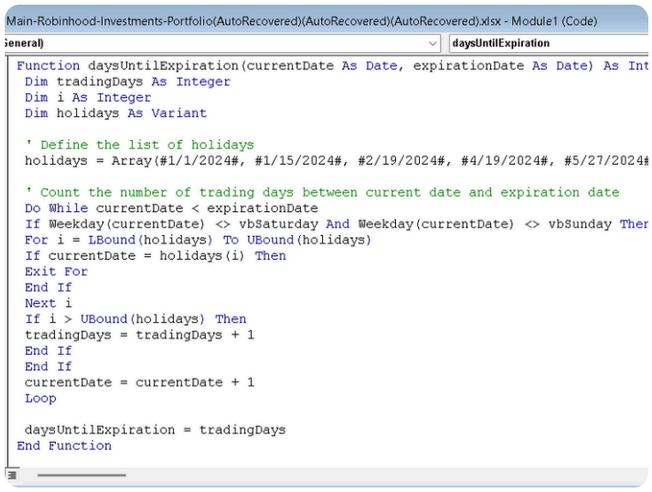
Includes the following:

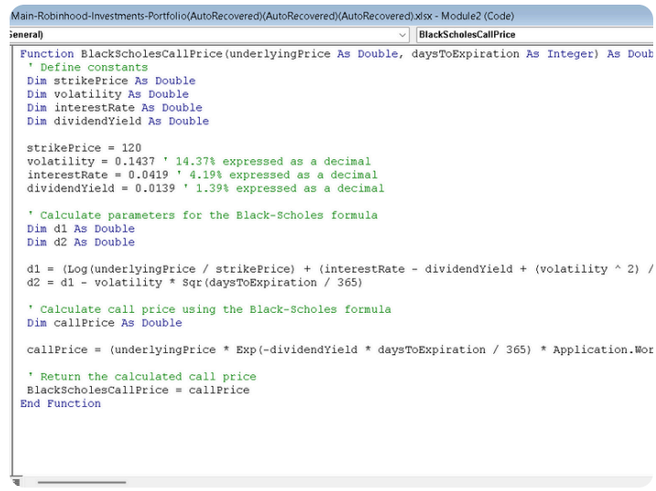
- Underlying strike price
- Strike price
- Volatility
- Interest rate(10 year Treasury rate)
- Dividend yield
- Time Until Expiration





In the images above, I created the charts above representing sell(top) and buy(bottom) call values given (+/-) % change in stock price and the trading day. However, I ran into two issues which I detail below.



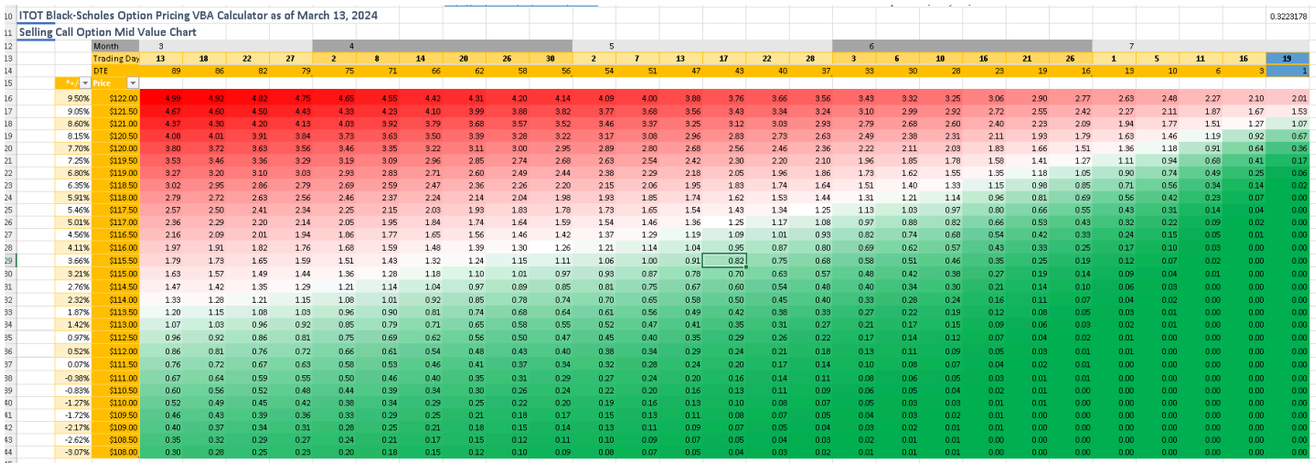


Issue 1: The trading days along the y-axis of the chart was not a unusable parameter, thus instead of manually doing the math for what each trading day had left in days until expiration, I opted to create a VBA module that would take the trading days and reference the official 2024 Trading Day Calendar(to avoid counting holidays and weekends) to give days until expiration.

Issue 2: Given that I attempted to squeeze the entire Black-Scholes equation into each cell which crashed my computer every time I refreshed the excel. I concluded that a VBA module for the Black-Scholes call price as an excel function would run better on my computer.

Final Result:

After comparing my values to Robinhood's Buy/sell option contract values of ITOT, I conclude that my option pricing model is accurate to that of Robinhood and presumably other brockerages.



ITOT Black-Scholes Option Pricing VBA Calculator as of March 13, 2024 — 0.3223178

Selling Call Option Mid Value Chart

Month	3				4							5							6							7				
Trading Day	13	18	22	27	2	8	14	20	26	30	2	7	13	17	22	28	3	6	10	16	21	26	1	5	11	16	19
DTE	89	86	82	79	75	71	66	62	58	56	54	51	47	43	40	37	33	30	28	23	19	16	13	10	6	3	1
*-/ Price																											
9.50%	$122.00	4.99	4.92	4.82	4.75	4.65	4.55	4.42	4.31	4.20	4.14	4.09	4.00	3.88	3.76	3.66	3.56	3.43	3.32	3.25	3.06	2.90	2.77	2.63	2.48	2.27	2.10	2.01
9.05%	$121.50	4.67	4.60	4.50	4.43	4.33	4.23	4.10	3.99	3.88	3.82	3.77	3.68	3.56	3.43	3.34	3.24	3.10	2.99	2.92	2.72	2.55	2.42	2.27	2.11	1.87	1.67	1.53
8.60%	$121.00	4.37	4.30	4.20	4.13	4.03	3.92	3.79	3.68	3.57	3.52	3.46	3.37	3.25	3.12	3.03	2.93	2.79	2.68	2.60	2.40	2.23	2.09	1.94	1.77	1.51	1.27	1.07
8.15%	$120.50	4.08	4.01	3.91	3.84	3.73	3.63	3.50	3.39	3.28	3.22	3.17	3.08	2.96	2.83	2.73	2.63	2.49	2.38	2.31	2.11	1.93	1.79	1.63	1.46	1.19	0.92	0.67
7.70%	$120.00	3.80	3.72	3.63	3.56	3.46	3.35	3.22	3.11	3.00	2.95	2.89	2.80	2.68	2.56	2.46	2.36	2.22	2.11	2.03	1.83	1.66	1.51	1.36	1.18	0.91	0.64	0.36
7.25%	$119.50	3.53	3.46	3.36	3.29	3.19	3.09	2.96	2.85	2.74	2.68	2.63	2.54	2.42	2.30	2.20	2.10	1.96	1.85	1.78	1.58	1.41	1.27	1.11	0.94	0.68	0.41	0.17
6.80%	$119.00	3.27	3.20	3.10	3.03	2.93	2.83	2.71	2.60	2.49	2.44	2.38	2.29	2.18	2.05	1.96	1.86	1.73	1.62	1.55	1.35	1.18	1.05	0.90	0.74	0.49	0.25	0.06
6.35%	$118.50	3.02	2.95	2.86	2.79	2.69	2.59	2.47	2.36	2.26	2.20	2.15	2.06	1.95	1.83	1.74	1.64	1.51	1.40	1.33	1.15	0.98	0.85	0.71	0.56	0.34	0.14	0.02
5.91%	$118.00	2.79	2.72	2.63	2.56	2.46	2.37	2.24	2.14	2.04	1.98	1.93	1.85	1.74	1.62	1.53	1.44	1.31	1.21	1.14	0.96	0.81	0.69	0.56	0.42	0.23	0.07	0.00
5.46%	$117.50	2.57	2.50	2.41	2.34	2.25	2.15	2.03	1.93	1.83	1.78	1.73	1.65	1.54	1.43	1.34	1.25	1.13	1.03	0.97	0.80	0.66	0.55	0.43	0.31	0.14	0.04	0.00
5.01%	$117.00	2.36	2.29	2.20	2.14	2.05	1.95	1.84	1.74	1.64	1.59	1.54	1.46	1.36	1.25	1.17	1.08	0.97	0.88	0.82	0.66	0.53	0.43	0.32	0.22	0.09	0.02	0.00
4.56%	$116.50	2.16	2.09	2.01	1.94	1.86	1.77	1.65	1.56	1.46	1.42	1.37	1.29	1.19	1.09	1.01	0.93	0.82	0.74	0.68	0.54	0.42	0.33	0.24	0.15	0.05	0.01	0.00
4.11%	$116.00	1.97	1.91	1.82	1.76	1.68	1.59	1.48	1.39	1.30	1.26	1.21	1.14	1.04	0.95	0.87	0.80	0.69	0.62	0.57	0.43	0.33	0.25	0.17	0.10	0.03	0.00	0.00
3.66%	$115.50	1.79	1.73	1.65	1.59	1.51	1.43	1.32	1.24	1.15	1.11	1.06	1.00	0.91	0.82	0.75	0.68	0.58	0.51	0.46	0.35	0.25	0.19	0.12	0.07	0.02	0.00	0.00
3.21%	$115.00	1.63	1.57	1.49	1.44	1.36	1.28	1.18	1.10	1.01	0.97	0.93	0.87	0.78	0.70	0.63	0.57	0.48	0.42	0.38	0.27	0.19	0.14	0.09	0.04	0.01	0.00	0.00
2.76%	$114.50	1.47	1.42	1.35	1.29	1.21	1.14	1.04	0.97	0.89	0.85	0.81	0.75	0.67	0.60	0.54	0.48	0.40	0.34	0.30	0.21	0.14	0.10	0.06	0.03	0.00	0.00	0.00
2.32%	$114.00	1.33	1.28	1.21	1.15	1.08	1.01	0.92	0.85	0.78	0.74	0.70	0.65	0.58	0.50	0.45	0.40	0.33	0.28	0.24	0.16	0.11	0.07	0.04	0.02	0.00	0.00	0.00
1.87%	$113.50	1.20	1.15	1.08	1.03	0.96	0.90	0.81	0.74	0.68	0.64	0.61	0.56	0.49	0.42	0.38	0.33	0.27	0.22	0.19	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.00
1.42%	$113.00	1.07	1.03	0.96	0.92	0.85	0.79	0.71	0.65	0.58	0.55	0.52	0.47	0.41	0.35	0.31	0.27	0.21	0.17	0.15	0.09	0.06	0.03	0.02	0.01	0.00	0.00	0.00
0.97%	$112.50	0.96	0.92	0.86	0.81	0.75	0.69	0.62	0.56	0.50	0.47	0.45	0.40	0.35	0.29	0.26	0.22	0.17	0.14	0.12	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00
0.52%	$112.00	0.86	0.81	0.76	0.72	0.66	0.61	0.54	0.48	0.43	0.40	0.38	0.34	0.29	0.24	0.21	0.18	0.13	0.11	0.09	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00
0.07%	$111.50	0.76	0.72	0.67	0.63	0.58	0.53	0.46	0.41	0.37	0.34	0.32	0.28	0.24	0.20	0.17	0.14	0.10	0.08	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00
-0.38%	$111.00	0.67	0.64	0.59	0.55	0.50	0.46	0.40	0.35	0.31	0.29	0.27	0.24	0.20	0.16	0.14	0.11	0.08	0.06	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00
-0.83%	$110.50	0.60	0.56	0.52	0.48	0.44	0.39	0.34	0.30	0.26	0.24	0.22	0.20	0.16	0.13	0.11	0.09	0.06	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
-1.27%	$110.00	0.52	0.49	0.45	0.42	0.38	0.34	0.29	0.25	0.22	0.20	0.19	0.16	0.13	0.10	0.08	0.07	0.05	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
-1.72%	$109.50	0.46	0.43	0.39	0.36	0.33	0.29	0.25	0.21	0.18	0.17	0.15	0.13	0.11	0.08	0.07	0.05	0.04	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-2.17%	$109.00	0.40	0.37	0.34	0.31	0.28	0.25	0.21	0.18	0.15	0.14	0.13	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-2.62%	$108.50	0.35	0.32	0.29	0.27	0.24	0.21	0.17	0.15	0.12	0.11	0.10	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3.07%	$108.00	0.30	0.28	0.25	0.23	0.20	0.18	0.15	0.12	0.10	0.09	0.08	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Buying Call Option Mid Value Chart

Month	3				4							5							6							7				
Trading Day	13	18	22	27	2	8	14	20	26	30	2	7	13	17	22	28	3	6	10	16	21	26	1	5	11	16	19
DTE	89	86	82	79	75	71	66	62	58	56	54	51	47	43	40	37	33	30	28	23	19	16	13	10	6	3	1
*-/ Price																											
9.50%	$122.00	4.99	4.92	4.82	4.75	4.65	4.55	4.42	4.31	4.20	4.14	4.09	4.00	3.88	3.76	3.66	3.56	3.43	3.32	3.25	3.06	2.90	2.77	2.63	2.48	2.27	2.10	2.01
9.05%	$121.50	4.67	4.60	4.50	4.43	4.33	4.23	4.10	3.99	3.88	3.82	3.77	3.68	3.56	3.43	3.34	3.24	3.10	2.99	2.92	2.72	2.55	2.42	2.27	2.11	1.87	1.67	1.53
8.60%	$121.00	4.37	4.30	4.20	4.13	4.03	3.92	3.79	3.68	3.57	3.52	3.46	3.37	3.25	3.12	3.03	2.93	2.79	2.68	2.60	2.40	2.23	2.09	1.94	1.77	1.51	1.27	1.07
8.15%	$120.50	4.08	4.01	3.91	3.84	3.73	3.63	3.50	3.39	3.28	3.22	3.17	3.08	2.96	2.83	2.73	2.63	2.49	2.38	2.31	2.11	1.93	1.79	1.63	1.46	1.19	0.92	0.67
7.70%	$120.00	3.80	3.72	3.63	3.56	3.46	3.35	3.22	3.11	3.00	2.95	2.89	2.80	2.68	2.56	2.46	2.36	2.22	2.11	2.03	1.83	1.66	1.51	1.36	1.18	0.91	0.64	0.36
7.25%	$119.50	3.53	3.46	3.36	3.29	3.19	3.09	2.96	2.85	2.74	2.68	2.63	2.54	2.42	2.30	2.20	2.10	1.96	1.85	1.78	1.58	1.41	1.27	1.11	0.94	0.68	0.41	0.17
6.80%	$119.00	3.27	3.20	3.10	3.03	2.93	2.83	2.71	2.60	2.49	2.44	2.38	2.29	2.18	2.05	1.96	1.86	1.73	1.62	1.55	1.35	1.18	1.05	0.90	0.74	0.49	0.25	0.06
6.35%	$118.50	3.02	2.95	2.86	2.79	2.69	2.59	2.47	2.36	2.26	2.20	2.15	2.06	1.95	1.83	1.74	1.64	1.51	1.40	1.33	1.15	0.98	0.85	0.71	0.56	0.34	0.14	0.02
5.91%	$118.00	2.79	2.72	2.63	2.56	2.46	2.37	2.24	2.14	2.04	1.98	1.93	1.85	1.74	1.62	1.53	1.44	1.31	1.21	1.14	0.96	0.81	0.69	0.56	0.42	0.23	0.07	0.00
5.46%	$117.50	2.57	2.50	2.41	2.34	2.25	2.15	2.03	1.93	1.83	1.78	1.73	1.65	1.54	1.43	1.34	1.25	1.13	1.03	0.97	0.80	0.66	0.55	0.43	0.31	0.14	0.04	0.00
5.01%	$117.00	2.36	2.29	2.20	2.14	2.05	1.95	1.84	1.74	1.64	1.59	1.54	1.46	1.36	1.25	1.17	1.08	0.97	0.88	0.82	0.66	0.53	0.43	0.32	0.22	0.09	0.02	0.00
4.56%	$116.50	2.16	2.09	2.01	1.94	1.86	1.77	1.65	1.56	1.46	1.42	1.37	1.29	1.19	1.09	1.01	0.93	0.82	0.74	0.68	0.54	0.42	0.33	0.24	0.15	0.05	0.01	0.00
4.11%	$116.00	1.97	1.91	1.82	1.76	1.68	1.59	1.48	1.39	1.30	1.26	1.21	1.14	1.04	0.95	0.87	0.80	0.69	0.62	0.57	0.43	0.33	0.25	0.17	0.10	0.03	0.00	0.00
3.66%	$115.50	1.79	1.73	1.65	1.59	1.51	1.43	1.32	1.24	1.15	1.11	1.06	1.00	0.91	0.82	0.75	0.68	0.58	0.51	0.46	0.35	0.25	0.19	0.12	0.07	0.02	0.00	0.00
3.21%	$115.00	1.63	1.57	1.49	1.44	1.36	1.28	1.18	1.10	1.01	0.97	0.93	0.87	0.78	0.70	0.63	0.57	0.48	0.42	0.38	0.27	0.19	0.14	0.09	0.04	0.01	0.00	0.00
2.76%	$114.50	1.47	1.42	1.35	1.29	1.21	1.14	1.04	0.97	0.89	0.85	0.81	0.75	0.67	0.60	0.54	0.48	0.40	0.34	0.30	0.21	0.14	0.10	0.06	0.03	0.00	0.00	0.00
2.32%	$114.00	1.33	1.28	1.21	1.15	1.08	1.01	0.92	0.85	0.78	0.74	0.70	0.65	0.58	0.50	0.45	0.40	0.33	0.28	0.24	0.16	0.11	0.07	0.04	0.02	0.00	0.00	0.00
1.87%	$113.50	1.20	1.15	1.08	1.03	0.96	0.90	0.81	0.74	0.68	0.64	0.61	0.56	0.49	0.42	0.38	0.33	0.27	0.22	0.19	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.00
1.42%	$113.00	1.07	1.03	0.96	0.92	0.85	0.79	0.71	0.65	0.58	0.55	0.52	0.47	0.41	0.35	0.31	0.27	0.21	0.17	0.15	0.09	0.06	0.03	0.02	0.01	0.00	0.00	0.00
0.97%	$112.50	0.96	0.92	0.86	0.81	0.75	0.69	0.62	0.56	0.50	0.47	0.45	0.40	0.35	0.29	0.26	0.22	0.17	0.14	0.12	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00
0.52%	$112.00	0.86	0.81	0.76	0.72	0.66	0.61	0.54	0.48	0.43	0.40	0.38	0.34	0.29	0.24	0.21	0.18	0.13	0.11	0.09	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00
0.07%	$111.50	0.76	0.72	0.67	0.63	0.58	0.53	0.46	0.41	0.37	0.34	0.32	0.28	0.24	0.20	0.17	0.14	0.10	0.08	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00
-0.38%	$111.00	0.67	0.64	0.59	0.55	0.50	0.46	0.40	0.35	0.31	0.29	0.27	0.24	0.20	0.16	0.14	0.11	0.08	0.06	0.05	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00
-0.83%	$110.50	0.60	0.56	0.52	0.48	0.44	0.39	0.34	0.30	0.26	0.24	0.22	0.20	0.16	0.13	0.11	0.09	0.06	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
-1.27%	$110.00	0.52	0.49	0.45	0.42	0.38	0.34	0.29	0.25	0.22	0.20	0.19	0.16	0.13	0.10	0.08	0.07	0.05	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
-1.72%	$109.50	0.46	0.43	0.39	0.36	0.33	0.29	0.25	0.21	0.18	0.17	0.15	0.13	0.11	0.08	0.07	0.05	0.04	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-2.17%	$109.00	0.40	0.37	0.34	0.31	0.28	0.25	0.21	0.18	0.15	0.14	0.13	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-2.62%	$108.50	0.35	0.32	0.29	0.27	0.24	0.21	0.17	0.15	0.12	0.11	0.10	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3.07%	$108.00	0.30	0.28	0.25	0.23	0.20	0.18	0.15	0.12	0.10	0.09	0.08	0.07	0.05	0.04	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00